

Test of time reversal invariance violation in the beta-decay of ^{56}Co

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Since the detection of CP violation in the neutral kaons,¹ there have been many attempts to detect the implied T violation in low energy phenomena. To date these searches have yielded no positive results, and for tests involving the beta-decay of the neutron the limits on T violation are quite small and are approaching limits of 10^{-4} .² Of course, without a good idea of the mechanism for T violation, present results do not rule out the existence of large effects in other systems.

The present work on ^{56}Co is motivated by the idea that T violation might appear through a mechanism that experiments involving allowed nuclear beta-decay are not sensitive to. One possibility is the existence of T violating second class currents. For the allowed decays of the neutron and ^{19}Ne , the dominant terms must be first class and hence any second class term would be kinematically suppressed.

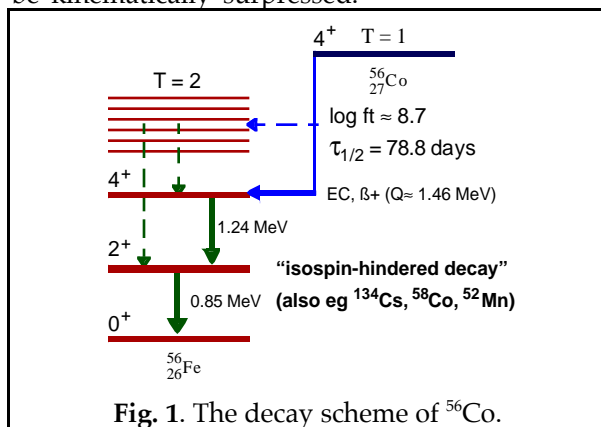


Fig. 1. The decay scheme of ^{56}Co .

In the decay of ^{56}Co this is not the case. Since it involves the decay between two different isospin multiplets (Fig. 1), the dominant terms need not necessarily be first class. The current limit on T violation in ^{56}Co is at the level of 10^{-2} . We intend to improve this by at least an order of magnitude.

The relevant correlation for the detection of TRIV is of the form $E1(J \bullet k)(J \bullet p \times k)$, where J is the nuclear spin, k is the gamma-ray momentum and p is the beta-momentum. The required

alignment will be achieved by low temperature nuclear orientation with an Oxford Kelvinox 400 that has been assembled and reaches temperatures of 5 mK. Unlike the previous effort,³ this dilution refrigerator will be capable of maintaining a stable temperature for weeks in a single run. The gamma-rays from the excited state of ^{56}Fe will be detected by conventional NaI(Tl) detectors. Besides stable refrigeration, the experiment has been improved by the development of a Si detector that operates at mK temperatures.⁴ This allows the detector to be placed very near the ^{56}Co source. A spectrum from ^{207}Bi is shown in Fig. 2. Results will be obtained by early 1998.

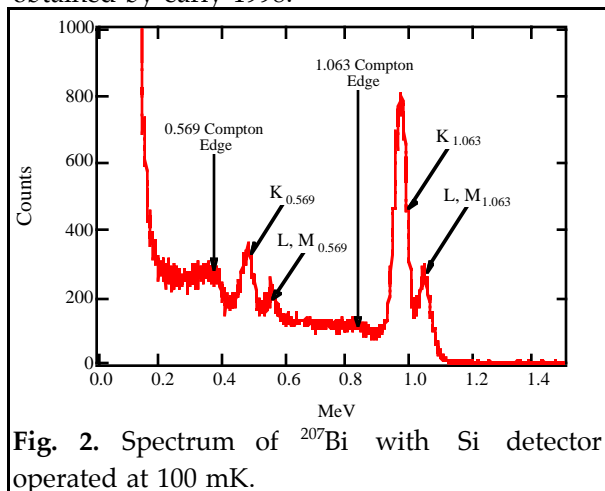


Fig. 2. Spectrum of ^{207}Bi with Si detector operated at 100 mK.

Footnotes and References

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4. We gratefully acknowledge the support of B. Young for the fabrication of this device.